

THE MCGURK EFFECT AFFECTED BY THE RIGHT EAR ADVANTAGE

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1. INTRODUCTION

It has been known since Broadbent (1954; cited in Hugdahl 2000) that, for most people, speech is better perceived in the right ear than the left. This is known as the Right Ear Advantage (REA). The explanation for this advantage is that most people are left-hemisphere dominant for speech processing and since this hemisphere receives most of its input from the right ear, the right ear dominates for speech. It should be noted that the strong tendency for the left-hemisphere to be dominant for language is less pronounced in left-handers (DeLeon 2005).

The most common demonstration of the REA is the dichotic listening test (e.g. Kimura 1961). In this test, subjects are simultaneously played two different syllables, one to each ear, and must report what syllable they perceive. Subjects tend to report the syllable that was played to their right ear. This test has been used as a simple behavioural test of hemispheric dominance for speech processing; however, the accuracy of this test is not impressive. Wada tests show that about 90-95% of right-handers are left-hemisphere dominant for language but only 80-85% show an REA in dichotic studies (DeLeon 2005). This is presumably due to the structure of dichotic listening tests, which, of necessity, bring in issues of word and sound frequency, attention and other possible confounds.

The current experiment provides a new behavioural measure of hemispheric dominance using the McGurk effect (McGurk and MacDonald 1976). The McGurk effect is an audiovisual illusion produced when auditory and visual sources of information give contradictory cues about the identity of a speech sound. For example, audio of a voice saying /aba/ dubbed over a video clip of a face saying /aga/ will typically be perceived as /ada/. The McGurk effect is dependent on the audio component being somewhat ambiguous – the more ambiguous the audio, the easier it is for the visual information to have an influence. Since the right ear is better at perceiving speech the McGurk effect should be harder to induce when the auditory component is played to the right ear. This experiment tests that hypothesis. If correct, this test may serve as a new diagnostic for hemispheric dominance.

2. METHOD

Subjects viewed audiovisual clips on a continuous loop. These clips consisted of a voice pronouncing /aba/ dubbed over video of a face saying /aga/, and so, with sufficient noise in the audio component, these clips would

induce an illusory perception of /ada/. The audio was either delivered to subjects' left ear, their right ear, or both ears. The 'both-ears' condition was included as a foil.

The level of white-noise masking was low at the start of each clip, so subjects would not initially experience the McGurk effect. Subjects raised the level of white-noise masking in the audio until their perception of the sound changed from /aba/ to /ada/, thus giving a measure of the relative amount of noise needed to induce the illusion in the left versus right ears.

2.1. Stimuli

Two speakers were recorded (audio and video) saying the disyllables /aba/ and /aga/. These sounds were chosen because the McGurk effect is harder to induce in the environment of low vowels (Green and Norrix 1997), and it is important to avoid ceiling effects (in which subjects always hear the illusory McGurk percept because the audio integrates so easily with the video).

One audio token of /aba/ and one video token of /aga/ from each speaker was chosen. The audio /aba/ tokens were normalized to 70dB and then dubbed over their respective video tokens of /aga/. Three versions of each of these stimuli were created. In one, audio was presented only to the left ear; in the second, audio was in the right ear; and in the third, audio was presented to both ears. In total, this means there were 6 different stimuli created (3 types of audio x 2 speakers). 12 copies of each of these stimuli were made to produce 72 experimental tokens.

2.2. Procedure

The experiment was conducted in a quiet room, with subjects wearing 'Extreme Isolation'® headphones. The stimuli were presented on a Dell Inspiron Laptop computer. The software used to run the experiment was developed by the author.

There were two stimulus-types of interest: monaural presentation to the left and right ear. These were not segregated into separate blocks, but were interleaved with each other and with the foil condition (presentation to both ears) in random order.

At the commencement of each audiovisual token, white-noise was delivered to the same ear that was receiving the auditory component of the token. Because the white-noise was very quiet, subjects typically perceived each token as

/aba/ when it first appeared on the computer screen. They then used the arrow buttons on the keyboard to raise the level of white-noise until they stopped perceiving the audiovisual token as /aba/ and started to perceive it as the illusory /ada/. When they had achieved the /ada/ percept, subjects used the mouse to click a button on the computer screen marked 'Done', and proceeded to the next token. There were 72 tokens in total (presented in random order) and subjects took a break after every 18 tokens.

2.3. Subjects

There were 13 subjects, 11 right-handed and 2 left-handed. All reported normal hearing and normal or corrected-to-normal vision. Subjects were paid ten dollars each for their participation.

3. RESULTS

Of the 13 subjects, 10 showed a Right Ear Advantage (REA). A separate t-test was conducted for each subject, and this REA was significant (at $p < 0.05$) for 5 of them.

9 of the 11 right-handers showed an REA and a sign test on these pooled results found that this was significant ($p = 0.032$), indicating that this REA is significant for the right-handers as a group.

Table 1. Subject handedness & whether they show an REA.

	Subject	Handedness	REA?	p-value of within-subject results
1	DD	Right	No	0.6856635
2	JD	Right	Yes	0.0273787
3	KJ	Right	Yes	0.3263987
4	JM	Right	Yes	0.0001427
5	KM	Right	No	0.0000001
6	MO	Right	Yes	0.2805566
7	GS	Right	Yes	0.0219312
8	KS	Right	Yes	0.3439654
9	GT	Right	Yes	0.0423531
10	JV	Right	Yes	0.7669372
11	JW	Right	Yes	0.2783214
12	HD	Left	No	0.0263171
13	ST	Left	Yes	0.0175788

It should be noted that while 2 of the right-handers showed a left ear advantage instead of a right ear advantage, only the results for one of these (subject 5: KM) was significant. The other right-handed subject without an REA (subject 1: DD) had a p-value of 0.685, suggesting that his lack of an REA was probably due to chance. If this is correct, then the rate of REA found in this sample is at least superficially consistent with the 90-95% rate of left-hemisphere dominance in the general population.

4. DISCUSSION

This experiment demonstrates that the REA makes the McGurk effect harder to induce when the audio is presented to the subject's right ear. This may serve as a new behavioural measure of hemispheric dominance for language. This test has the advantage of being easy to prepare and administer and furthermore avoids the confounds of word and sound frequency that interfere with the dichotic listening test.

Previous experiments using monaural presentation have typically only found a small REA and could only induce the REA when subjects were forced to make speeded responses (DeLeon 2005). The current experiment found a strong REA and did not require subjects to make speeded responses, and thus appears to be a reliable way to induce an REA with monaural presentation.

Some researchers (e.g. Kinsbourne 1970) have suggested that the REA is at least partially due to attentional factors (i.e. that people's attention tends to be drawn to sounds in their right ear). This experiment does not support that hypothesis since attentional factors are unlikely to have played a role here – the stimuli were presented monaurally and were played on a continuous loop, so subjects had plenty of time to attend to the relevant ear and had no sound in the opposite ear competing for attention.

The current study is too small to determine if the REA found using this methodology matches the 90-95% rate of left-hemisphere dominance in the general population, but the results look promising.

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